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a variable cycle third stream fan flow stream. That is, the generally planar second nozzle 12 may be a third stream exhaust nozzle which regulates a third flow stream selectively sourced from the fan section 101 and/or the compressor section 102. Notably, performance of engine 100 can be affected by regulating the secondary flow S by varying the generally planar secondary nozzle 12.

In this regard, reference is made to the perspective diagram of FIG. 3, which depicts an exemplary embodiment of the nozzle assembly 10 that incorporates a flexible panel 34. As shown in FIG. 3, flexible panel 34 at least partially defines the generally planar secondary nozzle 12 to influence the secondary flow S and thereby the primary combustion core gas exhaust flow E exiting through the nozzle assembly 10.

The flexible panel 34 is configured to be variably deflected along a range of positions between a full open position, at which the generally planar secondary nozzle 12 exhibits a maximum exit area, and a full closed position, at which the generally planar secondary nozzle 12 exhibits a minimum exit area. As the flexible panel 34 is variably positioned, the secondary flow S is selectively regulated.

The nozzle assembly 10 incorporates a support structure 32 located within a lower cavity 36. The support structure 32 is configured to provide alignment and structural support to the flexible panel 34 from the underside (i.e., the non-gas path side) as the flexible panel 34 is variably positioned. In some embodiments (such as in FIG. 3), the support structure 32 is a truss structure including multiple triangular units constructed with beam members whose ends are connected at joints.

The flexible panel 34 incorporates stiffening ribs 30 to maintain the throat profile of the nozzle assembly 10. The stiffening ribs 30 are structural stiffeners tailored to provide a desired aerodynamic shaping of the flexible panel 34 at key performance locations over the entire range of motion of the flexible panel 34. In this embodiment, the stiffening ribs 30 are formed of elongated strips of semi-rigid material extending across the width of the panel, although various other shapes, orientations and/or materials can be used in other embodiments.

In some embodiments, the flexible panel 34 may be all or partially comprised of a flexible elastomeric material, such as a fluorosilicone elastomer composite. Such a panel can be particularly well adept at sealing undesirable cracks and gaps. Metallics, organic composites, and ceramic composite materials are also envisioned to be suitable panel materials depending on placement within the panel structure and engine application. In higher temperature applications, for example, edge sealing could be performed with flexible metallic elements to cover cracks and gaps. Additionally, the relatively low translation and deflection requirements of the flexible panel 34 to vary the generally planar secondary nozzle 12 can result in reduced actuation load requirements for positioning the panel.

In some embodiments, the flexible panel 34 can incorporate a pressurized plenum 37 through communication of a selected portion of the secondary flow S through apertures 31 into lower cavity 36. The pressurized plenum 37 can be located, for example, on a side of the flexible panel 34 opposite the secondary flow S defined by the generally planar secondary nozzle 12. Such a pressurized plenum 37 is configured to provide pressure balancing of the flexible panel 34 to reduce actuation loads.

FIG. 4 is a schematic diagram depicting the nozzle assembly 10 of FIG. 3. As shown in FIG. 4, the secondary flow S passes through the secondary flow duct 114 and generally planar secondary nozzle 12. As the secondary flow S passes over the flexible panel 34, the secondary flow S is regulated by

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the generally planar secondary nozzle 12 as the shape is affected by the flexible panel 34 position.

Notably, stiffening ribs 30 are configured to deflect the flexible panel 34 to a desired shape in order to regulate the secondary flow S and affect engine performance. As the flexible panel 34 is deflected by the stiffening ribs 30, the generally planar secondary nozzle 12 is varied to operatively regulate the secondary flow S.

The stiffening ribs 30 are configured to be actuated via an actuator 42 that is coupled to the stiffening ribs 30 at actuation point 40. In this embodiment, actuator 42 moves the stiffening ribs 30 about actuation point 40 to vary the shape of the flexible panel 34. By way of example, actuator 42 can be a hydraulic motor, for example, located in the lower cavity 36 of the nozzle assembly 10.

The actuation mechanism between the actuator 42 and flexible panel 34 can be optimized for expected operating conditions and can incorporate one or more of a variety of linkages, levers, gears, and/or cam designs, chosen to facilitate reduced actuator loading yet increase operating speed.

It should be emphasized that the above-described embodiments are merely possible examples of implementations set forth for a clear understanding of the principles of this disclosure. Many variations and modifications may be made to the above-described embodiments without departing substantially from the spirit and principles of the disclosure. By way of example, in some embodiments, a flexible panel 34 can be configured to alter a nozzle throat asymmetrically in order to affect yaw vectoring of the flow. In some embodiments, this can be accomplished by the use of differential actuation of multiple actuators. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the accompanying claims.

The invention claimed is:

1. A nozzle assembly for a gas turbine engine comprising: a flexible panel adjacent a two dimensional secondary nozzle in communication with a secondary flow path for a secondary flow, said second flow path adjacent to a primary flow path for a primary flow, said flexible panel operable to selectively define a range of positions to regulate said two dimensional secondary nozzle; a cavity on a non-gas side of said flexible panel; and an actuator located in said cavity, said actuator configured to deflect said flexible panel, said actuator oriented in a direction that is non-parallel to an axis of rotation of the gas turbine engine.
2. The nozzle assembly of claim 1, further comprising: a stiffening rib configured to provide a desired aerodynamic shape to the flexible panel.
3. The nozzle assembly of claim 2, wherein said actuator is connected to the stiffening rib and is operative to position the stiffening rib such that the flexible panel is deflected.
4. The nozzle assembly of claim 1, wherein the flexible panel is configured to be placed in at least one of a throat area and an exit area of a third stream exhaust nozzle to variably open and close the exit area of the third stream exhaust nozzle and operatively regulate a third stream exhaust.
5. The nozzle assembly of claim 1, wherein the flexible panel is formed at least partially of an elastomeric material.
6. The nozzle assembly as recited in claim 5, wherein said secondary flow is selectively sourced only from a fan section of the gas turbine engine and said primary flow includes at least a combustion core gas exhaust flow sourced from a turbine section of the gas turbine engine and a flow from said fan section.
7. The nozzle assembly as recited in claim 5, wherein said secondary flow is selectively sourced only from a fan section